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The Management Conference—I

By staging a conference on the subject of management, the Council of Ironfoundry Associations have once again shown their pioneering spirit, for we believe that this is the first time that an employers' federation has ever deemed it worth while to review the fundamentals of their own activities. Held under the chairmanship of Mr. FitzHerbert Wright, a wide range of topics was discussed, and from some only a haze of recollections remains, but from others clear-cut advice was given. Into the first category enters "human relationships," but where the attraction of youth was concerned, it is obvious that enthusiastic apprentices are the best recruiting agents. There was general agreement that the Council's scheme for the training of apprentices was an enlightened one and, properly handled, would create the necessary enthusiasm. Doubt was expressed as to the suitability of the City and Guilds of London syllabus for the average entrant to the industry to-day. Something more elementary was needed. The immediate attachment of an entrant to a skilled moulder for training was decried, and special care in these early days was stressed. Insistence on attendance at technical evening classes did not meet with general approbation, and we think many agreed with the sentiments we expressed in this column many years ago, under the title of "A Volte Face." We then said that boys who had been working all day in a foundry would do better to participate in the evenings and at week-ends in Boy Scout activities in order that they should receive training in leadership. Mr. FitzHerbert Wright laid emphasis on the value to be had by sending trade lads to the Outward Bound Sea School for the recognised period of 26 days. After hearing an excellent account of the training system evolved by the National Coal Board, there was nothing shown to be in advance of what the foundry industry is promoting.

Advantage of the occasion was taken to examine the implications of the Garrett Report. Mr. H. A. Hepburn, his Majesty's Deputy-Inspector of Factories, stressed that many of the recommendations were already provided for by legislation passed in 1938, but were not sanctioned at that time so as to enable firms to concentrate on munition production. One of these comes into force on August 1. His department were now giving attention to those recommendations not so far covered by legislation. Work was going on to evolve a reliable dust concentration measuring apparatus; the discovery of new types of core bonds, which would evolve less obnoxious fumes than existing materials, and means for the reduction of carbon monoxide in foundry processes. The physical implementation of the recommendations was dealt with by Mr. J. W. Gardom, who detailed many cases where modernisation could be made to pay. We cite but two cases: (1) By suspending shanks on walls, which carry burners at suitable places, then not only can the bowls be more economically heated, but the installation of a simple canopy can remove the products of combustion. (2) By the provision of an expensive, well-insulated roof, the heating and ventilating costs can be lowered so as to pay for the innovations within a reasonable length of time.

Another major problem discussed was human relationship, and this aspect will be commented upon next week.

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Conference on Management

The Council of Ironfoundry Associations last Thursday and Friday organised, at Ashorne Hill, Leamington Spa, what is believed to be the first Conference on Management ever held by an employers' federation. It was presided over by Mr. FitzHerbert Wright, who, in his introductory remarks, stressed the need for a broader training for apprentices, so as to include, for example, a period with the Outward Bound training ship. The first address was given by Mr. Austen Alba, deputy director of the British Institute of Management, on "The Commonsense Application of the Basic Principles of Management." Covering a wide range of topics, the address, as the lecturer intended, gave rise to a long and interesting discussion.

Friday's programme opened with an address by Mr. J. E. A. King (Labour Manager, Stanton Ironworks Company, Limited) on "Incentives and the Best Use of Man-power in the Ironfounding Industry." This lecture threw into relief the steps taken by large undertakings to ensure that the various departments received the most suitable type of operative and, this done, the actions taken to make him a happy and contented member of an industrial team.

Next there was a brilliant address from Mr. Robert R. Hyde, the director of the Industrial Welfare Society, on "Human Relationships in Industry."

During the afternoon the delegates had details given to them as to how the National Coal Board is tackling the problem of training the entrants to the mining monopoly. This was given by Mr. M. J. M. Swanney, the Deputy Director of Recruitment and Training of that body. This was followed by an interesting talk by Mr. H. A. Hepburn (H.M. Deputy Chief Inspector of Factories), who reported upon the present position of the Garrett Report and indicated the lines the department were working on for the amelioration of working conditions in ironfoundries. This Report was also the subject of Mr. John W. Gardom's address, but his theme was the practical implementation of the recommendations. After dinner, the evening was given over to the showing of films germane to the general subject of management.

The organisation, which was excellent, was carried through by Mr. T. E. Parkinson, the secretary of the C.F.A., and by Mr. J. Butler, the assistant secretary.

Exchange Paper System Inaugurated

At the Metallurgy School, Melbourne Technical College, on June 16, a paper was presented on "Modernisation of the 'Small' Foundry" by Lester B. Knight. This was the first exchange paper submitted to the Institute of Australian Foundrymen by the American Foundrymen's Association, and it was presented by Mr. B. McD. Stewart, who had recently returned from a trip to the United States. It is interesting to recall that the first international exchange paper was presented to the Blackpool Conference of the Institute of British Foundrymen in 1921.

Catalogues Received

Tools and Gauges. A biscuit-coloured cover carrying vermilion lettering has been used by the Plessey Engineering Company, Limited, Amar Works, Grove Road, Chadwell Heath, Essex, in its latest catalogue. Combining tabular matter with white on black sketches, a great deal of technical data covering standard die sets, gap gauges, drill jigs, and the like, are presented in an easily digested form. The catalogue, which runs to 16 pages, is well illustrated.

Current Collection. A four-page folder received from the Morgan Crucible Company, Limited, Battersea, London, S.W.11, describes and illustrates the Morganite carbon insert for collecting current for cranes and trolley booms. The use of carbon is stated on technical grounds to give conditions superior to those ensuing from metal to metal contact. The folder is carried out in blue, with sepia for the photographic reproductions. This yields a pleasing result.

Band Saws. A leaflet neatly carried out in blue and white has been received from Metalclad, Limited, Gasworks Road, Neath, Glamorgan. It describes and illustrates a line of high-speed bandsaws of modern construction, and incorporating the following features:—Hinged metal doors which enclose the two wheels, and, when open, give full access to the working parts; a tensioning device; ball bearings; a table which cants and has an angle indicator and lock; a dust-extraction system and push-button operation. Two sizes—30 in. and 36 in.—are listed, both running at 750 r.p.m. Wisely, metric units have been tabulated alongside the normal figures in the leaflet. Commendable use has been made of the space available.

Cleanliness in Foundries

A New Order

The Minister of Labour and National Service has made the Factories (Cleanliness of Walls and Ceilings) (Amendment) Order, 1948 (S.I. 1948, No. 1674; H.M. Stationery Office, price 1d.), under the Factories Act, 1937, relating to the periodic internal cleaning of ironfoundries. Hitherto, some ironfoundries, or parts of them, have been exempt from the general requirement in that Act that inside walls, ceilings, etc., should be washed, painted, whitewashed or colour-washed at least once in every 14 months. Under the new Order, which comes into operation on August 1, 1948, all ironfoundries will be subject to that requirement except as regards those parts of walls, ceilings, etc., which are above 20 ft. from the floor.

The new Order gives effect to a recommendation made by a Joint Advisory Committee set up by the Chief Inspector of Factories to advise on methods by which general working conditions in ironfoundries could be improved.

The Casting of Marine Bronze Propellers*

By F. J. Tector, B.Eng., and J. Martland

(*Continued from page* 80.)

Sand Plant

A diagrammatic sketch of the main sand plant is shown in Fig. 16. The used moulds are broken down by light pneumatic picks and then fed through a grating at floor level into an impact-type crusher driven by a 35-h.p. motor. From the bottom of the crusher a belt conveyor conveys the material over a magnetic pulley to remove any tramp iron, and discharges it into the bottom of a bucket elevator which lifts it to vibrating screens at the top of the plant, where it is graded. Oversize pieces are returned to the crusher and undersize grains rejected to a silt hopper. From the screens the graded and reconditioned sand is discharged into a ready-use bunker of 80 tons capacity. The two August-Simpson mixing mills are loaded by two independent bucket elevators, which can be charged either with reconditioned sand from the storage hopper or new sand from adjacent bunkers. Cement is also added at this stage. After a short dry mix, water is sprayed into the mills, the amount being regulated by easily visible water meters at the charging station. The mills are fitted with air-operated doors to enable them to be operated by the foundry labourers who take away the mixed sand to the propeller sites in rubber-tyred bogies.

Dust is exhausted from the plant at all points where it is produced, notably just below ground level at the intake grid, from the bucket loader charging stations, and the mixing mills. It is conveyed to a bag house outside the foundry, where it is collected and removed.

Sand Handling

Reconditioned sand and new sand mixed with the appropriate amounts of cement and water are delivered from the mixing mills to the various sites by means of 700-lb. turn-over skips mounted on pneumatic-tyred bogies. This method of transportation is very easy, as a level concrete floor is provided. At each moulding site a 10-cwt. electrically-operated jib crane is provided which is used to lift the skip from the bogie and dump the sand on to the job as required. By this means, manual effort in shovelling is obviated and moulding is not dependent on the overhead travellers. Heavy lifts in the main foundry block are provided for by 32-ton cranes in the heavy bay, 12-ton cranes in the medium bay and a 5-ton crane in the light bay. These cranes are used for handling the complete mould tops, for casting purposes, and for removal of the finished casting.

*A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. R. R. Hargreaves presiding. The authors are on the staff of the Manganese Bronze & Brass Company, Limited.

Moulding and Casting Small Propellers

During the last war a special foundry was laid out for the batch production of small propellers, *i.e.*, propellers weighing from about 10 lb. to 2 cwt., which were required in large numbers for motor torpedo boats, landing craft and similar vessels. Although, due to many changes in the numbers and sizes of propellers following the continual development of the vessels themselves, it was impossible to plan comprehensively, a production system was evolved which enabled large numbers to be produced rapidly, and over 12,000 propellers were produced in the later war years.

Moulds were made on a production line using a simple "oddside" process. The first stage was the production of a solid metal pattern which was produced in the ordinary way from a single-blade wooden pattern. After the pattern propeller had been made and checked two permanent "oddsides" were made, one for the back and one for the face of the propeller. These "oddsides" were made in special cast-iron boxes which were carefully registered with each other. The mould parts, top and bottom, were then made in moulding boxes which registered with the "oddside" boxes, using the metal propeller pattern to produce the appropriate face. These mould parts were made by hand in batches on a conveyor using the Randupson sand-cement process. The subsidiary mould parts for head rings, runners, etc., were made in batches on small moulding machines. The moulds were poured from tilters, production flow being arranged so that moulds made during the night were cast the day but one following.

Production Notes

The propeller foundries described in this Paper produced in 1947 a gross issue weight of 3,734 tons, this being, as far as the Authors are aware, the highest tonnage of propellers ever produced in a single year by any single works in the world. This tonnage was completed despite the three weeks' national electricity shutdown and another week lost in the year when cement supplies failed. The total effective floor area for moulding is approximately 25,000 sq. ft., giving an average output of 15 tons per 100 sq. ft. of space, working five days per week. The skilled hours taken per ton cast have steadily fallen and now show an improvement of about 25 per cent. on pre-war figures. Strictly comparable figures as between loam moulding and sand-cement moulding are not available, but a rough comparison would indicate, on present-day results, an improvement of at least 40 per cent.

The Authors are convinced that these results have been obtained mainly because the sand-cement process makes it possible to organise and arrange all the foundry operations in the most efficient way. All stages are planned and casting schedules are arranged at a minimum two weeks in advance. In particular, to obtain the maximum possible benefit from the two clear days at the week-end, jobs are brought to a stage where this drying period can effectively be utilised without serious

prejudice to the overall time necessary to produce a casting.

From the foundry workers' point of view, the sand-cement process is greatly favoured, mainly on account of the clean working conditions. This can best be understood by a comparison of photographs of the old and new foundries. An effective bonus system is also in operation which has contributed to some extent to the results achieved.

In conclusion, the Authors would like to express their thanks to the directors of the Manganese Bronze & Brass Company for permission to publish the information contained in the Paper.

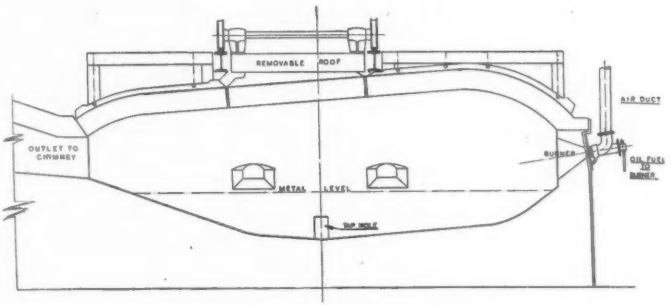


FIG. 14.—OIL-FIRED REVERBERATORY FURNACE.

DISCUSSION

Permeability of Cement Sand

MR. HULME (Oldham) asked for information respecting the permeability of the sand. How did it compare with ordinary moulding material?

MR. MARTLAND replied that the sand was so permeable that ordinary instruments would not enable a comparative reading to be given. Tobacco smoke could be blown through a 2-in. core, 4 in. long, quite easily. The sand had very good moulding properties and would sleek up as fine as was necessary.

MR. HULME asked how cement-sand practice compared with ordinary moulding technique in respect to costs.

MR. TECTOR replied that the sand was comparatively expensive, mainly because a suitable type was not readily obtainable everywhere. The sand used was brought from Leighton Buzzard to the extent of about 70 to 80 tons per week at present, and the price was 30s. 2d. per ton. A considerable proportion of this cost was accounted for by freight charges. This was definitely a disadvantage and it was particularly so at the present time, when it was not possible to arrange production so as to secure the maximum use from used beds. Normally, if production were at an economic level, the same beds could be used many times merely by re-facing them, but when working at maximum production level the changing of jobs that was necessary to suit delivery dates and the resulting breaking down of beds caused much sand to be lost.

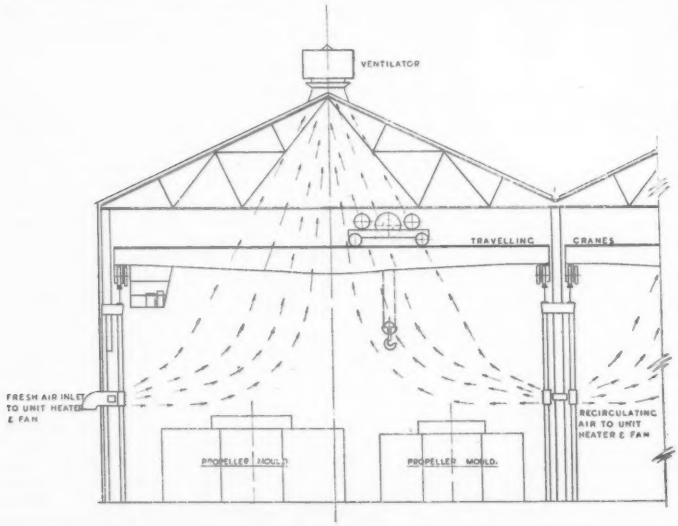


FIG. 15.—VENTILATION OF THE PROPELLER FOUNDRY.

Alternative Supplies

MR. VAN DER BEN (Ashton-under-Lyne) mentioned the possibility of using sand of finer grade. Did it necessarily require to be 20/50 mesh size, or would a sea-sand of 60/90 mesh be suitable? Why was it necessary to have such an open-grain permeable sand; could not work be done with a finer grained type?

MR. MARTLAND replied that dune sand had been used successfully for the sand-cement process during the war years for small propellers for landing craft with casting weights of about 1½ cwts. This sand was used once and then discarded. For heavy work the

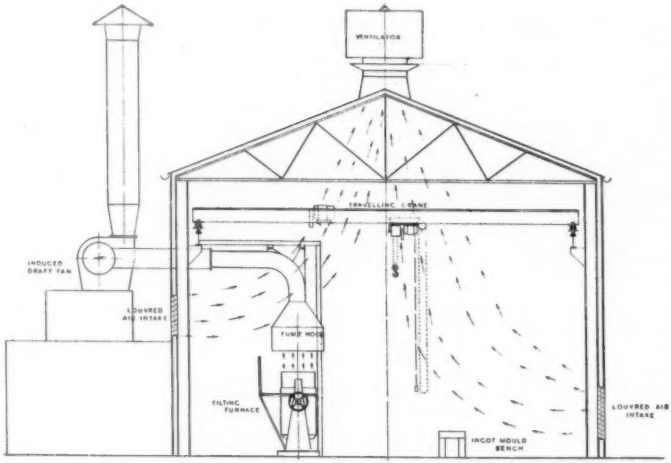


FIG. 16.—VENTILATION SYSTEM OF THE INGOT FOUNDRY.

more open grain was preferable, and an important advantage was that it could be reconditioned without an excessive reduction in grain size which cause a dangerous loss of permeability.

Pitch Control

MR. VAN DER BEN said he was interested in the remarks with regard to the accuracy of angle and pitch in a propeller blade. An interesting case was the production of a propeller with eight blades, where four auxiliary blades were superimposed on the four main blades. This method had some connection with slip efficiency, and the experiment was carried on for quite a long time. The rail method was new to him as a means of sweeping up the primary face of the blade. There was one practice adopted which came within his knowledge, to have metal-sheet templates placed on radii round the foundry bed. He presumed that the process which had been described was not applicable to variable pitches.

MR. TECTOR replied that the strickling process was applicable to variable pitch propellers ...

MR. VAN DER BEN remarked that the propellers he had in mind were nearly all of variable pitch. How could such a system be arranged?

MR. TECTOR explained that, although the method was more complicated, it could be confirmed that most types of variable pitches could be struck by combinations of pitch rails. In the case of his own firm, the propeller design department and the foundry worked in close co-operation. As an example of this, by means of a special device worked out on the drawing board, it was possible to strike the variable pitch of the hyperbolic type illustrated in the Paper. There were also methods of striking almost any other variation of pitch by means of compound rails. There was one system in particular where two rails were used on the root and two rails on the tip with the striking board arranged in hinged sections so that the various portions of the pitch surface could be swept. This method was quite practical and worked very well.

MR. VAN DER BEN asked if Mr. Tector considered this was an advantage over the system of sheet-metal templates round the bed?

MR. TECTOR replied that he did; it was a simpler method.

Cast-iron Propeller Practice

MR. HOWELL said that about 20 years ago he was attached to a foundry whose production consisted mainly of marine propellers made in cast iron. They attained a maximum of 16 ft. dia. and weighed, perhaps, 12 tons.

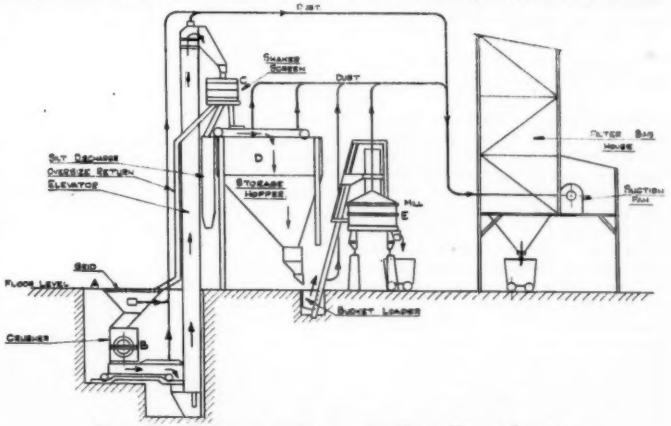


FIG. 17.—DIAGRAM SHOWING THE SAND PLANT LAYOUT.

The Casting of Marine Bronze Propellers

They were made in three days. Four men were engaged upon them on the first day. They got the beds struck up and the moulds were stoved on the first day. The next day, templates were put on the beds and the blades made up. Eight men rammed up the tops, stripped them, blacked them, and put them back in the stove. The next day four men went back on the job and the job was cast by 5.30. He thought the time, in all, was under 200 hrs. Could the Authors give any idea as to how long it would take to make up a propeller of that sort? Of course, he was speaking of cast-iron propellers, whereas the Authors had dealt with the manganese-bronze type.

Another point which occurred to him was that, when molten metal was spilt upon a concrete floor, an explosion took place, the metal being thrown about in all directions. It was an amazing advance to be able to cast metal in sand in the manner described in the Paper, and it could be realised what amount of work and what amount of experimenting had been undertaken to perfect the process.

MR. MARTLAND replied, saying that there was no real comparison between the method of manufacture recalled by Mr. Howell and that described in the Paper, as it would appear that, in the first case, unlimited manpower was available, whereas in the second case large-scale economic production with the most effective use of skilled labour was being discussed. In the case of the Randupson process, the setting time of the cement was the controlling time factor, and the least possible time necessary to produce a bronze propeller casting would be 10 days if all the rules were properly observed. There was, however, no doubt that the total skilled man-hours taken to produce a 12-ton propeller would be appreciably less than the 200 man-hours mentioned. In ordinary production work, never more than two moulders were engaged on the job at one time, with the exception, of course, for the actual casting operation.

Concrete Floors Not Dangerous

MR. TECTOR replied to Mr. Howell's second point when he referred to the danger of explosion when molten metal was spilt on a concrete floor. He said that in the early days of the process this possibility was a " bogey." With the new process they, naturally, had teething troubles and in the first two years experienced a dozen or so run-outs of varying severity, and in some cases quite considerable amounts of molten metal reached the concrete floor, but in no case was there even a minor explosion. Consequently, it could be stated with confidence that there is little ground for fear in this respect. Much depended, of course, on the age of the concrete floor and, no doubt with a floor that had only recently been laid and still retained some moisture in it, the danger would be more likely to exist. He would like to point out, however, that the method of bolting up the moulds was tackled on sound engineering lines and that, now the correct practice had been established, the possibility of failure in this direction was very remote.

Moulding Methods

MR. HAROLD HAYNES (Ashton-under-Lyne) asked why were three men using the board, as shown on one of the illustrations. Was it difficult to use the strickle with the sand-cement process? A second point was: How was the material rammed on the face, and how far were the ashes below the face? Was scabbing encountered?

MR. MARTLAND explained that the formation of scabs was almost an impossibility. With regard to ashes, they were not used in the Randupson method. Normally, there was a covering of rough sand to a depth of 6 in. before applying the facing sand on top.

MR. HAROLD HAYNES asked how much would be allowed for ramming in; was two or three inches enough?

MR. MARTLAND said that with a heavy casting up to 20 tons there would be 4 in. of facing sand and an equivalent number of inches of rough sand over the venting space. Ramming was quite unnecessary; there was a packing of sand rather than a ramming. The method of ramming was similar to oil-sand practice.

MR. HAROLD HAYNES asked why it was apparently so hard to push the striking board.

MR. MARTLAND said that sometimes it was not possible to balance the striking board exactly. The boards were not always horizontal and sometimes a considerable rake was used. Occasionally it was found that there was a drag on the bottom of the board towards the boss, and the pushing up with a stick was merely to ensure that in the sweeping of the bed in the final stages it was done in one continuous sweep without any sticking.

MR. COLLINGE said that in one of the slides he had noticed a stand, which he presumed was made up of a cast-iron base, and three steel rods rising vertically to support the top. He thought that a taper pillar, or a pillar pipe, would have been more efficient. Actually, he had seen that with steel stands there had been vibration and sometimes there had been serious accidents.

MR. MARTLAND said that the stands in the illustration were of an old pattern inherited from a rather distant past: There were many others in use which were more modern and which looked, and were, more suitable. Mr. Collinge was not the first person to query the supporting of the tops. They looked colossal on the floor, especially when supported by the rather frail-looking stands, but it should be remembered that they were on a firm concrete floor where there was no vibration, and he had not experienced any difficulty with them.

Tolerance

MR. TEISDELL (Scotland) remarked that a tolerance of 0.040 in. in thickness had been mentioned. How could static balance be obtained with such fine thickness tolerances?

MR. TECTOR was afraid he had not quite understood the last question. There was a pitch tolerance on the complete propeller after machining of plus or minus ½ per cent. Then there was what was termed a local pitch tolerance over 12-in. spans of 1 per cent. Superimposed again on that tolerance was a thickness tolerance which was normally plus

or minus a millimetre, or roughly 0.040 in. After working to such tolerances, a 15-ton propeller would be within reasonably close limits of static balance. The final correction of balance was done by chipping and grinding weight off a heavy blade, which could be done within the thickness tolerances allowed, particularly when it is remembered that the balancing is done in successive stages. The pitch face was, of course, always finished first, and it was quite practicable to obtain both the thickness tolerances mentioned, together with correct static balance, which were necessary for high-class work.

MR. TEISDELL asked what had been the experience in the lift of blades and the relation to the setback. Could the setback be made deep enough without provision in the mould? Was there trouble in the lifting during cooling in regard to the setback?

MR. TECTOR said there was no trouble experienced. There could be no lift because of the bolting.

MR. MARTLAND remarked that one of the features bearing upon the question was the rigidity of the Randupson sand-cement process. The tops were held and bolted in position. The propellers were designed so that they drew naturally without any lift from the tips. When the tops were removed, there was no distortion observable.

Ventilation

MR. VAN DER BEN was very interested in the ventilating system. Did the louvred intakes set low in the foundry wall create any problem due to draught?

MR. TECTOR thought they would and, consequently, they were not used in the main shop. In the ingot foundry, where they were used, there was a great degree of heat most of the time, and it was very seldom that there were complaints of draughts except in very cold weather conditions. In their standing time the furnacemen went to the other side of the shop, where the louvres were very high up, and did not stand near those which were low down.

Economics of Melting

MR. D. FLEMING (Manchester) asked for an explanation of why ingot metal was melted in such a multiplicity of small furnaces rather than in a large unit where the rate of temperature rise was probably well under control. Where there was a huge battery of small furnaces, the analytical demand for checking a large number of small melts would be very considerable.

MR. TECTOR felt that he could not properly do justice to this inquiry as he was not a metallurgist. Attempts had been made to make manganese bronze in larger quantities than the methods described and, it is believed, even in reverberatory furnaces, but, as far as the Authors are concerned, they did not favour this practice and considered that a better product could be obtained and better control maintained with the 600-lb. nominal heats than with bigger units. He agreed that it might be possible to go up to, say, 1,000-lb. heats, but he said he had had no personal experience of these sizes. It was, of course, necessary to analyse a greater number of heats, but, providing an adequate staff were available for this purpose, he thought it was worthwhile.

MR. J. FLEMING replied that personal experience in bronzes was that, with a modern type of furnace, the greater the size of charge being dealt with, the closer the control, but his firm only went up to about 60 lbs. at a time. He would regard a 120-lb. plant as a small headache.

MR. TECTOR said that he was referring to nominal 600-lb. tilters. They made a 680- to 700-lb. heat.

MR. F. A. HARPER (Rochdale), dealing with the character of the metal used, assumed that care would have to be exercised with regard to returned propellers. There would have to be very great accuracy with regard to the ingot metal produced. How were the blades sheared off?

MR. TECTOR said that only scrap from jobs the firm had manufactured, and of which they knew the analysis, was used. Propeller blades were drilled off, although it was admitted that almost every visitor to the works who saw this process expressed their surprise. Generally, drilling had, however, been found to be the quickest method in practice, and it paid to use a modern high-efficiency radial drill for this purpose. The only system which made an appeal to him, but which he had not been able to try out, was the Oxy-Arc method, which used a combination of electric arc and oxygen cutting. It should be remembered, however, that the cutting off of large propeller blades involved thicknesses up to 10 and 12 in.

MR. F. A. HARPER assumed that a series of holes would have to be drilled.

MR. TECTOR explained that the work was done very quickly by men used to the method. In the case of very large propellers, each blade was usually cut into four pieces by chain drilling and the boss similarly cut through into four sections. This might appear to be a very formidable job, but it was carried out very much quicker than might be imagined.

Casting Temperatures

MR. COLLINGE asked for information respecting casting temperature. Were there any set standards for casting different sections?

MR. MARTLAND replied that the average casting temperature was 990 to 995 deg. C. for jobs up to 9-ft. dia., and 895 to 990 deg. C. for the heavier type.

MR. HAROLD HAYNES asked, if propellers were made in cast iron under the cement process, would they be as successful as with the manganese bronze?

MR. MARTLAND said that, as far as he knew, cast-iron propellers had not been made in Randupson sand cement. Other iron castings had been dealt with very successfully.

Cavitation Erosion

MR. WALLIS understood that at one time the propellers of turbine-driven ships only lasted a short while. Then, by the addition of nickel, an alloy was produced which resisted erosion and corrosion. He understood, also, that there had been some talk of this alloy being dropped, and that aluminium bronze should be used more extensively.

MR. TECTOR said that the question of what was termed cavitation erosion of propellers was an old one, and much trouble had been experienced many years ago when the problem was not fully understood. Design

methods had, however, improved considerably, mainly over the past 10 or 15 years, a large amount of information having been derived from the systematic testing of Aerofoil shapes. Consequently, it is now possible to design propellers by fundamental methods instead of experimental ones. Cavitation erosion was, at one time, a very serious matter and, as an example, the original propellers of the "Normandie," which were made to a French design, eroded so badly after the first few trips that they had to be replaced. On the other hand, a pair of propellers which were supplied in 1938 to a famous British liner were still in use on this particular ship, despite the fact that she had done a really phenomenal ocean mileage during the war as a troopship and they were still in first-class condition and good for many more years' service. It is, therefore, true to say that cavitation erosion is practically non-existent nowadays, even with the normal manganese-bronze propeller alloys. It can be mentioned, in passing, that a nickel-aluminium-bronze propeller alloy, as suggested by Mr. Wallis, has already been developed by the Manganese Bronze & Brass Company, and will shortly be available for large marine propellers. This alloy would, he was sure, represent a still further step forward in propeller technique.

MR. FLEMING said he had done some jet cavitation erosion work involving similar problems from a metallurgical point of view. This had caused him to study the subject closely and endeavour to discover the facts of the relative resistance of the materials. Personally, he would place aluminium-nickel-bronze in a position much above that of stainless steel in respect to resistance. In his opinion, if the propeller cavitation problem had had to be solved by the metallurgist, he could not have done it; only the propeller designer could make the step forward which had been taken.

Vote of Thanks

MR. TOM MAKEMSON, M.B.E., in proposing a vote of thanks to the Authors, said the Branch had always been keen on having practical Papers dealing with the actual making of moulds, and stressing the craftsmanship of the foundry. The Paper that they had just heard fulfilled these requirements admirably, and, furthermore and incidentally, it gave a great deal of information with regard to the Randupson process.

MR. E. J. L. HOWARD (Manchester), in seconding, complimented the Authors upon their description of foundry ventilation.

The vote of thanks was carried unanimously by acclamation.

MR. TECTOR, in responding on behalf of the Authors, thanked the speakers for their remarks, but confessed that he was not actually a foundryman himself, but an engineer. Therefore, he was grateful for the very able co-operation of Mr. Martland, who had rendered such valuable service in the preparation of the Paper. He would also like, on Mr. Martland's and his own behalf, to acknowledge the valuable help given by Mr. Haxell, the foreman patternmaker of the Manganese Bronze & Brass Company, for his valuable and expert assistance in the preparation of the models exhibited, and to his company for their permission to present the Paper.

New Catalogues

Heat Resisting Steels. Hadfields, Limited, East Hecla Works, Sheffield, have well maintained the deservedly high reputation they have won for their trade publications by the issue of this 44-page brochure. It is jacketted in Royal blue, with the title picked out in embossed orange lettering. The technical portion is clearly written in simple language, and the illustrations have been chosen for their "publicity" appeal. This is the balance to be sought in publications of this character. There is a nice range of pictures of high grade heat resisting castings, such as are used by vitreous enamellers, case hardeners, and furnace designers. The sole criticism called for is the use of the orange coloured small type on page 4, as it somehow or other induces an unpleasant dazzle. The reviewer suggests that the use of the black type as on the lower half of page 5 would have been preferable.

Hand Torches. The tool described in a folder received from Chance Brothers, Limited, Engineering Division, Lighthouse Works, Smethwick, 40, Birmingham, is in no way connected with those used during the "black-out." Known as the Flamemaster, it is a neatly designed tool, burning town's gas or hydrogen or bottled gases with compressed air or oxygen. It is used for such jobs as soldering, lead burning, brazing and light welding. The folder is carried out in yellow and black, the latter being used to depict excellent photographs of the flames obtained with the various gases. With the folder is included a price list of the torch and its components from W. Edwards & Company (London), Limited, Kangley Bridge Road, Lower Sydenham, London, S.E.26, who are the sole United Kingdom export agents for the Flame Torch.

X-Ray Facilities Enhanced

On July 31 a new company—Newton Victor, Limited—comes into being, amalgamating the activities of Victor X-Ray Corporation, Limited, Newton & Wright, Limited, and the X-ray research and manufacturing interests of the Metropolitan-Vickers Electrical Company, Limited, under the ægis of the Associated Electrical Industries, Limited.

As a single, wholly British, enterprise devoted to the design, production, distribution and servicing of X-ray equipment for all industrial purposes, the new company will, through a network of branches and service stations located in the principal centres of industry throughout the United Kingdom, continue and expand the facilities hitherto provided by its constituent members to users and prospective users of such apparatus. An extensive new factory at Motherwell, Scotland, has been established in addition to existing production facilities at Finchley and Brixton.

The head offices of Newton Victor, Limited, will be at 15, Cavendish Place, London, W.1.

Nodular Cast Irons, Their Production and Properties*

By H. Morrogh and J. W. Grant†

(*Continued from page* 86.)

Acicular and Martensitic Cast Irons

Nodular cast irons may be alloyed with nickel and molybdenum or with copper and molybdenum for the purpose of obtaining acicular or martensitic structures. As would be expected, nodular irons alloyed in this manner develop an extremely high level of mechanical properties which is capable of further improvement by tempering. Table XVI gives the analyses of three such alloyed cast irons, and Table XVII gives their respective mechanical properties. Material V.985, which had a metallic matrix of the acicular structure and martensite together with a little ferrite, was tested in the as-cast condition and after tempering at 320 deg. C. for five hours, standard test-bars being used. Materials W.57 and W.79 were cast in the form of horizontal 1.2-in. bars each 12 in. long and as shaped tensile bars 0.564 in. diameter, and both were tested after tempering for five hours at 320 deg. C. Material W.57 was only partially acicular, having about 50 per cent. of the matrix in the form of ferrite, whereas material W.79 had a good acicular structure together with a little ferrite around the nodules. All three materials were produced by the double-treatment process.

TABLE XVI.—*Chemical Composition of Three Alloyed Cast Irons.*

Melt No.	T.C, per cent.	Si, per cent.	Mn, per cent.	S, per cent.	P, per cent.	Ce, per cent.	Ni, per cent.	Cu, per cent.	Mo, per cent.
V.985	3.58	3.07	0.80	0.008	0.040	0.038	2.04	—	0.58
W.57	3.42	2.96	0.81	0.007	0.042	0.056	—	2.51	0.64
W.79	3.32	2.95	0.82	0.014	0.031	0.059	2.15	—	0.69

Heat-treatment of Nodular Cast Irons

All nodular cast irons may be subjected to heat-treatment for the purpose of obtaining special structures and mechanical properties, without noticeable effect on the graphite structure.

1. *"Dead" Annealing or Softening Annealing*

The object of this form of heat-treatment is usually to make the material completely ferritic and hence to obtain it in its softest and most ductile condition. Nodular irons readily respond to this annealing, the time necessary to produce the completely ferritic structure depending upon the composition and the section size—in general the smaller the section size the more rapidly does the pearlite break-down occur, due to the finer dispersion of the graphite nodules. Unalloyed nodular irons of up to ½ in. section and having 3.5 to 3.9 per cent. total carbon and 2.5 to 3.0 per cent. silicon can be completely "dead-annealed" by heat-treatment for about 2 hours at 700 to 750 deg. C. The most efficacious heat-treatment for this purpose is, however, that involving heating to above the critical range, say, 900 deg. C., followed by slow cooling in the furnace.

To illustrate the influence of annealing upon double-treated nodular cast irons the results given in Tables XVIII and XIX are quoted. These results were obtained on four different nodular irons heat-treated at 650 and 700 deg. C. for 2 hours and 8 hours, followed by air-cooling, and at 900 deg. C. followed by furnace cooling. Micro-examination of the annealed bars showed that considerable pearlite break-down had taken place in all cases, but traces of spheroidised pearlite remained in the bars annealed at 650 and 700 deg. C., the amount being less for the longer annealing times. The break-down was most complete in the bars slowly cooled from 900 deg. C.

The tensile strengths and moduli of elasticity decrease as the amount of spheroidised pearlite decreases, but there is no regular trend in percentage elongation. The as-cast bar NOD. 225 gave a total elongation of 5.5 per cent., and after annealing for 2 hours at 700 deg. C. an elongation of 8 per cent. This is the greatest elongation which has been recorded on a nodular cast iron except in the case of austenitic materials. Un-alloyed nodular irons having silicon contents of 2.3 to 3.0 per cent. give Brinell hardness numbers of 130 to 180 when annealed to the completely ferritic condition.

2. *Quench-tempering and Normalising*

Nodular irons respond to quenching, tempering and normalising in a manner similar to that of ordinary grey irons. By quenching and tempering, improvements in tensile strength of up to 100 per cent. may be obtained, and by normalising, that is, heat-treatment above the critical range followed by air-cooling, improvements of up to 30 per cent. in tensile strength have been achieved. The results given in Table XX illustrate the influence of quenching and tempering and normalising a single-treatment un-alloyed nodular iron.

* Presented at the London Conference of the Institute of British Foundrymen, June, 1948.

†The Authors are on the staff of the British Cast Iron Research Association.

Nodular Cast Irons

One sample of this material was also dead-annealed by slow-cooling from 900 deg. C. The as-cast structure of this iron consisted of a mixture of hyper-eutectic nodules and quasi-flake graphite in a matrix of ferrite and pearlite. The quench-tempered bars had a metallic matrix of tempered martensite, the slowly-cooled bar was completely ferritic, and the air-cooled (normalised) bar had a matrix of fine pearlite.

The Production of Nodular Cast Irons

A survey has now been made of the mechanical properties of a few typical nodular cast irons, and it will be readily appreciated that their properties possess many attractive features. With nodular cast irons it is possible to achieve a very high level of transverse and tensile strength with relatively low hardness figures. The shock-resistance of unalloyed nodular irons may be three to five times better than that of flake-graphite cast irons and this may be considered as the outstanding feature of the material. The problem immediately arises as to how this new cast iron can be produced commercially and on an industrial scale. Much further work remains to be done on this aspect of the problem and various possibilities have still to be explored. It is the purpose of this section of the Paper to discuss some of the difficulties and possibilities with regard to the commercial production of the material.

TABLE XVII.—*Mechanical Properties of the Irons Detailed in Table XVI.*

Melt No.	Diameter as-cast.	Transverse rup. stress, Tons per sq. in	Deflection, in.	Tensile strength, Tons per sq. in.	B.H.N.
V.985. As cast	1.6 in. 1.2 in. 0.875 in. 0.6 in.	81.2 72.1 78.2 63.5	0.45 0.47 0.30 0.17	37.1 39.8 32.5 Unmachinable	352 401 492 —
V.985. Tempered at 320 deg. C. for five hours	1.6 in. 1.2 in. 0.875 in. 0.6 in.	77.4 89.9 90.1 125.1	0.31 0.47 0.25 0.28	47.4 42.6 43.2 51.7	373 412 451 477
W.57. Tempered at 320 deg. C. for five hours	1.2 in. 12 in. long 0.564 in. shaped tensile	— —	— —	40.4 46.0	242 285
W.79. Tempered at 320 deg. C. for five hours	1.2 in. 12 in. long 0.564 in. shaped tensile	— —	— —	50.8 55.2	335 325

The composition requirements for nodular cast irons have been described in an earlier section. The most important elements for control purposes are carbon and sulphur. If a low-sulphur hematite pig-iron be available, experience has shown that it is not difficult to meet the required conditions when melting in crucible, electric-arc furnaces, resistor furnaces and high-frequency induction furnaces. With such melting equipment it is possible to limit the carbon loss on melting to a very low figure, and since there is usually no sulphur pick-up it is possible to produce nodular cast irons merely by melting a pig-iron of appropriate composition and then to treat the metal after or during tapping in the ladle. These batch-type melting units are, however, among the least important melting units available in the foundry. Nodular cast irons can be produced, and successful large scale industrial tests have been conducted, using the cupola furnace. With 100 per cent. pig charges it is possible to tap hyper-eutectic carbon contents, but there is always a sulphur pick-up which cannot be avoided in normal practice and even through the sulphur content of the charge may be low, the sulphur content of the metal tapped will normally be too high to allow immediate treatment with *mischmetall* on an economic basis. The higher the sulphur content of the metal to be treated, the larger is the amount of cerium which is required to reduce the sulphur to the maximum permissible. For instance, with sulphur contents of the order of 0.1 per cent., an addition of as much as 0.6 per cent. *mischmetall* may be required to give a final sulphur content of less than 0.02 per cent., and about 0.05 per cent. cerium in the final casting. On the other hand, when the sulphur content of the metal to be treated is of the order of 0.02 per cent., only about 0.1 to 0.2 per cent. *mischmetall* is required to give the same yield of cerium.

De-sulphurising Treatment

Due to the sulphur pick-up in normal cupola practice, it is in general necessary to interpose a preliminary

TABLE XVIII.—*Composition and Tensile Strength of Nodular Irons.*

No.	Cast diameter.	T.C. per cent.	Si, per cent.	Mn, per cent.	S, per cent.	P, per cent.	Ce, per cent.	Cu, per cent.	Average tensile strength, tons per sq. in.
NOD.222 ..	1.2 in.	3.42	3.00	0.86	0.002	0.046	0.084		31.9
NOD.239 ..	1.2 in.	3.47	2.36	0.81	0.027	0.032	0.062	2.00	37.0
NOD.242 ..	1.2 in.	3.63	2.91	2.01	0.011	0.044	0.058		32.2
NOD.225 ..	0.875 in.	3.65	2.97	0.54	0.027	0.028	0.036		29.8

TABLE XIX.—*Tensile Strengths of Irons Detailed in Table XVIII after Heat Treatment.*

Melt No.	Property.	As-cast.	2 hrs. 650 deg. C.	8 hrs. 650 deg. C.	2 hrs. 700 deg. C.	8 hrs. 700 deg. C.	Furnace-cooled from 900 deg. C.
NOD.222 ..	Tensile, tons per sq. in. ..	31.9	29.9	29.3	29.2	28.1	27.2
	Elongation, per cent.	3.0	2.0	4.0	3.5	3.0	3.0
	Modulus of elasticity, lb. per sq. in. × 10⁶	24.2	24.0	23.5	24.3	24.4	22.4
NOD.239 ..	Tensile, tons per sq. in. ..	37.0	34.0	30.4	29.4	28.1	28.6
	Elongation, per cent.	1.5	2.0	3.0	3.0	3.5	5.0
	Modulus of elasticity, lb. per sq. in. × 10⁶	23.8	—	24.4	—	—	23.3
NOD.242 ..	Tensile, tons per sq. in. ..	32.2	32.2	31.6	30.4	27.6	29.2
	Elongation, per cent.	1.0	1.5	1.5	1.5	1.0	3.0
	Modulus of elasticity, lb. per sq. in. × 10⁶	23.4	—	24.5	—	—	22.8
NOD.225 ..	Tensile, tons per sq. in. ..	28.8	27.8	28.0	29.6	—	24.0
	Elongation, per cent.	5.5	5.0	3.5	8.0	—	3.0
	Modulus of elasticity, lb. per sq. in. × 10⁶	23.1	—	—	—	—	21.5

de-sulphurising treatment in the ladle. If the sulphur content of the metal tapped from the cupola be within the range of 0.05 to 0.08 per cent., it may be possible to de-sulphurise the metal sufficiently by one treatment with soda-ash in a basic-lined ladle, but if the original sulphur content be higher than 0.08 per cent., the "double ladle" technique of de-sulphurising might have to be applied. Assuming that a sufficiently low sulphur content can be obtained to warrant only one de-sulphurising treatment, then the procedure required would seem to involve tapping the metal from the cupola into a basic-lined (preferable "tea-pot" type) ladle containing soda-ash; after the reaction has subsided the slag may be thickened and skimmed off and the metal treated with cerium by throwing *mischmetall* on to the surface of the metal and stirring in; this could be followed by an addition of inoculant, if necessary. Alternatively, after skimming the thickened soda-ash slag from the ladle the metal can be poured into a ladle containing the *mischmetall*, together with the inoculant if required.

TABLE XX.—*Influence of Heat Treatment on Unalloyed Nodular Irons*

Composition: T.C. 3.56 per cent.; Si, 2.88 per cent.; Mn, 0.54 per cent.; P, 0.035 per cent.; S, 0.007 per cent.; Ce, 0.048 per cent.

Bar size and treatment.	Transverse rup. stress, tons per sq. in.	Deflection, in.	Tensile strength, tons per sq. in.	B.H.N.	Impact strength, ft.-lb.
1.6 in., As-cast ..	45.1	0.43	—	—	—
1.2 in., As-cast ..	49.0	0.69	24.2	190	—
0.875 in., As-cast ..	54.6	0.35	—	—	47
0.6 in., As-cast ..	68.1	0.31	28.6	256	—
1.2 in., 900 deg. C. oil-quenched, tempered, 3 hr. 450 deg. C. ..	—	—	53.4	368	—
0.875 in., do.	—	—	55.6	363	—
0.875 in., slowly cooled from 900 deg. C.	—	—	21.0	143	—
0.6 in., air-cooled from 900 deg. C. ..	—	—	38.9	266	—

If the "double ladle" technique of de-sulphurising be applied, the metal from the cupola will be run into the first ladle containing the soda ash and then the mixture poured into the second ladle in which the slag can be thickened and then skimmed off. In general this double-ladle technique can only be applied with relatively large amounts of metal, as otherwise there is a serious loss in temperature. The *mischmetall* may be added to the surface of the metal in the second ladle, but if a large amount of metal is to be treated it is difficult to obtain uniform solution by stirring, and it is preferable then to place the *mischmetall* in the bottom of the first ladle and to pour the metal from the second ladle on to it. The treated metal can then be cast from the first ladle.

The mechanical properties given in Table XXI illustrate the results which can be obtained from a cupola operating under commercial conditions. All-pig charges (3.87 T.C, 2.68 Si, 0.66 Mn, and 0.03 per cent. S) were melted in a balanced-blast cupola and tapping temperatures in excess of 1,400 deg. C. were obtained. The metal was tapped into 5-cwt. capacity basic-lined ladles containing soda-ash, the slag was thickened and skimmed off, *mischmetall* was added and plunged in and then the inoculant was added and plunged in with a refractory plunger. The microstructures of all the bars of this set had nodular graphite structures.

TABLE XXI.—*Properties of Commercially-made Nodular Irons.*

Composition after treatment: T.C., 3.69 per cent.; Si, 2.77 per cent.; Mn, 0.63 per cent.; S, 0.005 per cent.; P, 0.045 per cent.; Ce, 0.057 per cent.

Test bar diameter, in.	Transverse rup. stress, tons per sq. in.	Deflection, in.	Tensile strength, tons/sq. in.	Brinell hardness number.
3.0*	47.4	0.51	37.9	241
2.1	63.6	2.14	—	—
1.6	67.9	1.30	—	—
1.2	61.4	0.95	35.9	218
0.875	77.6	0.83	—	244
0.6	80.0	0.53	34.2	—

* Tested on 18 in. centres in transverse.

Nodular Cast Irons

Basic-cupola Melting

The use of the basic cupola may provide a means of obtaining high carbon contents and low sulphur contents even with at least an appreciable part of the charge made up of steel scrap, but this furnace has not yet been tried for the production of nodular cast irons.

Much metal coming directly from the blast furnace is of ideal composition for treatment with *mischmetall* for the production of nodular cast irons and this may provide a relatively cheap way of producing high-duty cast irons for casting near to the blast furnace. It should be noted here that cerium is usually lost on re-melting and it is therefore not possible to treat a pig iron with the element and then to remelt it and obtain nodular structures.

TABLE XXII.—*Properties of Nodular Cast Iron Made by Using Simultaneous Additions.*

Composition: T.C, 3.71 per cent.; Si, 2.96 per cent.; Mn, 0.54 per cent.; S, 0.010 per cent.; P, 0.033 per cent.; Ce, 0.051 per cent.

Transverse rupture stress (tons per sq. in.)	66.5
Deflection (in.)	0.60
Tensile strength (tons per sq. in.)	32.2
Brinell hardness number	241
Impact strength (ft.-lb.)	71

Mischmetall will dissolve readily in all low phosphorus and low sulphur cast irons to give a satisfactory yield of cerium at temperatures in excess of 1,300 deg. C. The optimum temperature range appears to be 1,350 to 1,450 deg. C. With metal temperatures of below 1,300 deg. C. there may be a deposition of hyper-eutectic flake graphite in the liquid metal before the addition is made. Flake graphite already in existence before the addition is made is unaffected by the addition of cerium. This flake graphite may have a harmful effect on mechanical properties so that the metal temperature should always be in excess of about 1,300 deg. C. for compositions lying between 3.5 and 4 per cent. total carbon and 2.3 and 3 per cent. silicon.

It has been found that, for the purpose of the double treatment process, the cerium-containing addition must dissolve before the inoculant and obviously, therefore, the best way to ensure this is to add the *mischmetall* and, after it has dissolved, to add the inoculant. This method does, however, entail certain difficulties in routine production, but it has been found that, in the case of 80 per cent. ferro-silicon and S.M.Z., the *mischmetall* and inoculant may be added simultaneously by putting the two together at the bottom of the ladle and running the metal on to them. Under these conditions the *mischmetall* probably dissolves more rapidly than the inoculant and so the correct order of solution is obtained. The results given in Table XXII illustrate the mechanical properties of a nodular iron prepared in this way, cast in a 1.2-in. bar. The inoculant in this case was S.M.Z. and the microstructure of the material was almost completely nodular with only a trace of the quasi-flake graphite.

Influence of Phosphorus

For the best mechanical properties in nodular cast irons it is necessary that the phosphorus content should be as low as possible and preferably below 0.1 per cent. Phosphorus, besides having a directly harmful influence, reduces the solubility of cerium in the melt and with phosphorus contents in excess of about 0.5 per cent. it is not possible to dissolve sufficient cerium in the melt to have the required effect. The results presented in Table XXIII illustrate this point.

A 300-lb. crucible furnace melt of hematite pig-iron was poured in four successive taps, an addition of ferro-phosphorus was made to the metal remaining in the crucible after each tap, and each ladle of metal was treated with the same amount of mischmetall. The bars from Taps 1, 2 and 3 had hyper-eutectic nodules and quasi-flake graphite, but the bars from Tap 4 had

TABLE XXIII.—*Influence of Phosphorus on Nodular Irons.*

No.	Chemical Composition.						Bar size, in.	Transverse rupture stress, tons per sq. in.	Deflection, in.	Tensile strength, tons per sq. in.	B.H.N.	Impact, ft.-lb.
	T.C, per cent.	Si, per cent.	Mn, per cent.	S, per cent.	P, per cent.	Ce, per cent.						
1	3.78	2.67	0.52	0.018	0.024	0.040	1.6	40.0	0.30	19.8	182	
							1.2	40.8	0.35	22.3	186	
							0.875	44.0	0.27	24.0	216	35
							0.6	48.4	0.16	31.7	231	
2			0.52	0.014	0.29	0.035	1.6	28.7	0.18	17.2	192	
							1·2	34·1	0·23	17·8	205	
							0.875	38.3	0.16	20.5	229	17
							0.6	41.0	0.14	22.2	229	
3			0.51	0.016	0.47	0.024	1.6	25.6	0.18	17.0	197	
							1.2	31.2	0.23	18.2	209	
							0.875	34.5	0.15	19.6	215	14
							0.6	38.5	0.12	20.3	235	
4			0.46	0.018	0.57	0.010	1.6	19.9	0.17	10.1	159	
							1.2	21.5	0.20	11.1	172	
							0.875	25.6	0.13	11.9	200	8
							0.6	28.6	0.11	14.1	229	

normal graphite structures. It will be seen that although the same addition of mischmetall was used in each case, the yield of cerium decreases with increasing phosphorus content until with 0.57 per cent. phosphorus the amount of cerium is only 0.010 per cent., that is, below the minimum of 0.020 per cent. required to give the nodular structure. Considering the mechanical properties of the first three taps, it will be seen that even though the treatment has been effective in modifying the graphite structure in each case, the influence of phosphorus in lowering the level of mechanical properties is marked.

Summary and Conclusions

A brief account has now been given of the process whereby grey cast irons can be obtained having nodular graphite structure in the as-cast state and an attempt has been made to give a detailed survey of the mechanical properties of a number of typical nodular cast irons. This Paper is not intended to serve as a guide to those intending to produce nodular cast irons —it being beyond the scope of any one Paper to present all the necessary details—but some of the difficulties and possibilities in the commercial production of the material have been referred to.

Nodular cast irons represent a new material and with a material of this nature much work is required before a full appreciation of its possibilities can be realised. This must therefore be considered as a preliminary account, to be amplified and modified at a later date as more results and experience are obtained.

The development of nodular cast irons is the outcome of many years' research on the subject of graphite formation. The process itself is relatively complex and the metallurgical background out of which it has developed is somewhat unusual. Many of the concepts which have served so well for ordinary cast irons are no longer applicable to the new material. The production of nodular graphite structures in the manner which has been described depends upon a delicate series of chemical and physical reactions and hence the ultimate commercial development of the process will involve rigid technical control. The method which has been described may be supplanted at a later date by newer and improved methods, but it is believed that their basic features will be similar to those already outlined. At least, it is felt, it can justly be claimed that nodular graphite structures are no longer the unique characteristic of conventional malleable cast irons produced by the heat-treatment of white cast iron. A new field in the metallurgy of cast iron has been opened which may eventually have tremendous possibilities.

Whilst the production of nodular structures provides an interesting field for theoretical speculation, it is appropriate to consider the mechanical properties of this material with the new type of structure. Has it any useful mechanical properties? In this context it must be immediately pointed out that the material, whilst having some of the microstructural characteristics of malleable cast iron, does not possess the mechanical properties of conventional malleable cast iron. Nodular cast irons are still relatively non-ductile and brittle and they do not exhibit a yield point, although their shock-resistance is very much superior to that of the best high-duty flake-graphite irons. There are obvious reasons for this difference between the nodular cast irons and malleable cast irons. Nodular cast irons have, compared with most malleable cast irons, relatively high carbon and high silicon contents, and in the as-cast state are subject to all the heterogeneity of any as-cast material. There is evidence that by appropriate heat-treatment nodular cast irons may develop a measure of ductility, but this is still largely a matter for future work.

Compared with flake-graphite irons, nodular cast irons can be produced having transverse rupture stresses and tensile strengths as good as, and better than, those of accepted high-duty cast irons. In addition, these high values may be obtained at a relatively low level of hardness and with shock-resistance figures as high as two to four times those of high-duty grey cast irons.

The damping capacity of nodular cast irons is appreciably lower than that of any flake-graphite cast iron. Insufficient work has been carried out upon the fatigue properties of nodular cast irons to permit a conclusive comment, but the indications are that endurance ratios of approximately 0.5 may be expected. In addition, the evidence available suggests that nodular cast irons are more notch-sensitive than grey irons in a dynamic test, but less sensitive in a static test. Stress/strain curves for nodular cast irons are essentially of the same type as those for flake-graphite irons, but nodular cast irons are characterised by relatively lower plastic strain at low and relatively high plastic strain at high loads. It will be seen from these brief comments that nodular irons possess mechanical properties which might render the material particularly suitable in the field of engineering applications where high strength and shock-resistance are required, together with good machinability. By appropriate heat-treatment or by the use of special alloying elements the mechanical properties of nodular cast irons can be raised to a very high level. Some typical examples have been given, but interest in nodular cast irons quite naturally centres around the use of the un-alloyed material in the as-cast state.

Commercial Production

The commercial production of nodular cast irons has to contend with two main difficulties: first, the high carbon contents, and second, the low sulphur contents required. For many years in the production of high strength cast iron, the emphasis has been upon the utilisation of controlled low carbon contents and therefore the demand for high carbon contents requires a fresh approach to the problems of melting and raw materials in the ironfoundry. There is nothing intrinsically or metallurgically difficult in the production of high carbon contents and it is possible that the future will see important developments in this connection. Low sulphur contents are, perhaps, more difficult to achieve, largely because of the necessity, in most British foundries, of using the cupola furnace. It is not essential to de-sulphurise cupola-melted metal, but,

Nodular Cast Irons

unless this be done, a considerable waste of cerium alloy will occur. If basic-lined ladles be used, the soda-ash process for de-sulphurisation is efficient, but most foundries will prefer to avoid a process involving the treatment of the metal in the ladle with several successive additions. At the moment there is no easy way around this difficulty and soda-ash de-sulphurisation will have to be applied with cupola melting. Again, however, the problem of de-sulphurisation in the ironfoundry is still a field of considerable possibilities. For instance, it is possible that the use of the basic-lined cupola may provide a satisfactory solution to the whole problem.

It will be gathered from the foregoing remarks that much further work requires to be carried out on the production of nodular cast irons. The stage has been reached, however, when the work must be carried out on a large scale under industrial conditions. The process, as it has been described, is now no longer a matter for the laboratory and extensive field tests are being conducted on an increasing scale. If nodular cast irons possess a commercial future, the rate at which they are adopted will depend to a large extent upon the ability of the industry successfully to deal with the new problems involved.

Acknowledgments

The Authors desire to thank the Council of the British Cast Iron Research Association for permission to publish the work recorded in this Paper. They are also indebted to several of their colleagues on the staff of the Association who have assisted in various aspects of the work described. In this connection they wish to record their indebtedness to Mr. W. J. Williams, to Mr. W. Westwood and Mr. A. Mayer for providing suitable analytical techniques, and to Mr. D. Marles of the Association's metallography laboratory.

Correction

On page twenty-seven of the July 8 issue of the JOURNAL it was recorded in the Paper on "Nodular Cast Irons" that the sulphur content might be reduced from 0.6 per cent. to 0.02 per cent. by the addition of cerium. The statement should read "reduced from 0.06 per cent. to 0.02 per cent." In last week's printed "correction" of this error the mis-statement was wrongly quoted.

REFERENCES.

1 Morrogh, H., and Williams, W. J., Journal of the Iron and Steel Institute, 1947, March, pp. 321-371.
2 Morrogh, H., and Williams, W. J., Paper No. 875, 44th Annual Meeting, 1947, Institute of British Foundrymen.
3 Morrogh, H., and Williams, W. J., Journal of the Iron and Steel Institute, 1948, March.
4 Morrogh, H., American Foundryman, 1948, April.

THE PRODUCTION of pig-iron in Australia's two main companies—Broken Hill Proprietory Company and Australian Iron & Steel, Limited, is decidedly less than in 1940. The joint production in that year was 1,182,588 tons; last year it fell to 936,776 tons.

Book Reviews

The Law of Trade Unions. By H. Samuels M.A., Barrister-at-Law. (Third Edition.) Published by Stevens & Sons, Limited, 119 and 120, Chancery Lane, London, E.C.2. Price 6s.

That two new editions of this book, which was reviewed on page 182 of our issue of February 14, 1946, have been necessary, stresses both its use and popularity. The opinions then expressed are unchanged.

Foundry Rhymes. By Alex. Russell. Published by the Author from 4, McVicar's Lane, Dundee. Price 6d. net.

The reviewer doubts his ability to appraise the artistic merit of poetry which embraces much Scottish vernacular, but he recognises in certain of the verses a real touch of genius. The sentiments running through the whole series tend very much towards the left. The type of foundry described in no way portrays those the reviewer has visited in the Glasgow area.

Heat Convection from Finned Tubes. By E. Harrison. Published by Emmott & Company, Limited, 31. King Street West, Manchester, 3. Price 2s. 6d.

This little book, which incorporates much mathematics and a dozen or so graphs, is restricted to the study of the film rate of heat transfer on the extended surface side of the heater. As many foundries make castings embodying cooling fins, it may be that some desire to know something of their thermal efficiency. If this be so, here is a cheap and reliable source of information.

House Organs

Murex Review. Published by Murex, Limited. Rainham, Essex.

This is the first issue of a bulletin to be published quarterly. The major part of the first issue is devoted to the use of stainless steel in the chemical and food processing industries—an article by Mr. J. A. MacWilliam. There is a second article on Vanadium, Tungsten and Molybdenum in the Colour industries; the balance is made up of abstracts.

The Nickel Bulletin. The May issue of The Nickel Bulletin has an interesting article on cast iron—"Large-Scale Production of Miscellaneous Castings in High-Duty Grey Iron." The two main factors which markedly influence the final structure and the mechanical properties of cast iron (cooling rate and chemical composition) are dealt with in some detail and the article is illustrated with excellent line drawings of the Lloyd's (Burton), Limited, foundry.

In addition, there are many abstracts of varied interest covering electrodeposition, constructional steels and heat- and corrosion-resisting alloys. Under the latter heading there is an unusual application in that of nickel chromium stainless steels in bone surgery. The Nickel Bulletin is obtainable free of charge from The Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1.

Law Reports

London Scrap Merchants Heavily Fined

Fines amounting to £400 were imposed on a Camden Town (London) firm of scrap-metal merchants by the Clerkenwell Magistrate on July 15 for acquiring pig-lead except under authority and in accordance with the regulations of the Ministry of Supply.

William Sargent, of Fox Lane, Palmers Green, London, N.13, pleaded not guilty to receiving on a date unknown before June 15 at 32A, Hartland Road, Camden Town, 1 ton 15¾ cwt. of pig-lead knowing it to have been stolen, and to receiving, between June 17 and July 1, 11 cwt. of pig-lead. He pleaded guilty to two charges of acquiring the lead improperly.

James Albert Stimpson, of Perth Road, Wood Green, London, N.22, foreman to Messrs. Sargent, who had appeared at a previous hearing on charges of receiving, was discharged, it being explained that, as no proof could be found of any larceny of the lead, the charges of receiving could not be proceeded with. The charges of receiving against Sargent were also dropped, and he was tried on the two charges involving breach of regulations only.

Mr. I. P. L. Jones, solicitor, prosecuting, said that Sargent's firm sent its scrap metal through Saxton & Company, of Kentish Town, and it was noticed at the Millwall lead works of Locke, Lancaster, that ingots of pig-lead were being found in the scrap. A check was kept, and the ingots were traced through Saxton to Sargent. When interviewed by the police, Sargent said he did not buy the ingots and asked them to have a look round. A small quantity of pig-lead was found. The ingots had the marks defaced and were broken up. Sargent said his foreman was on holiday, and he himself had just returned from holidays. Asked about the defaced marks, Sargent said: "You know what it is like in this trade. The people I buy from say that if they did not knock the marks out I would not buy it." His suppliers said they had bought some pig-lead from people who had gone out of business.

Photographs of the markings on ingots were produced to show that one ingot had on it the number 609, from which it could be shown that it was smelted on June 17, a time when Sargent was attending his business. There were no proofs of larceny. The pig-lead had been dealt with in the ordinary course of business by Sargent.

Det.-Sergt. Blue said that Sargent had been in the scrap-metal business since leaving school and had traded with Saxton for the past 20 years. There was nothing known against him.

On Sargent's behalf, it was said that he had been on holiday until June 12, had looked in on Monday and had then continued his holiday. He did not return to business until June 21.

The Magistrate (Mr. Frank Powell) imposed a fine of £300 or three months, with 20 guineas costs, on the first charge and £100 or one month, consecutively, on the second.

Petitions Dismissed

Lord Sorn, in the Court of Session, has dismissed petitions for the liquidation of two Glasgow companies —Howard Engineering Supplies (Glasgow), Limited, and Norman E. Potts (Scotland), Limited, machine-tool and machinery merchants, of Glasgow—at the instance of Mr. N. E. Potts, with expenses against him.

Iron and Steel Subsidies

Review to be made in the Autumn

Iron and steel subsidies are to be reviewed in the autumn. An announcement to this effect was made by Mr. G. R. Strauss, Minister of Supply, in the House of Commons last week when he replied to a question by Mr. Granville Sharp, who asked the Minister for details of the financial assistance made to the steel industry.

Mr. Strauss said that the amounts involved would depend on the actual imports of steel, pig-iron and scrap. The following estimates for the current financial year were based on import programmes which, in the first quarter of the year, were not fully realised:—Imported steel, £8,600,000; imported pig-iron, £345,000; imported scrap, £4,800,000; Ministry of Supply steelworks, £250,000; freight on imported iron ore, £7,300,000; uneconomical production of home ore, £700,000; making a total of £21,950,000. The Minister said it would be appreciated that this financial assistance kept down the price of steel to the user.

The Minister also stated that, with the increase in total steel production and the improvement in foreign supplies, arrangements were being made to supply the independent wire drawers within the next three months with the same share of all available rods as they had before the war.

Space at Next Year's B.I.F.

Plans for the 1949 British Industries Fair, which will be held in London and Birmingham from May 2 to May 13, are well advanced, and already application forms for space have been despatched. These are returnable by August 7 and inquiries already to hand indicate that the demand will be exceptionally heavy. Last year more than 600 late applicants could not be accommodated.

As on previous occasions, certain trade associations are co-operating with the Export Promotion Department of the Board of Trade in the arranging of uniform schemes of presentation. Participation in these special arrangements is not confined to association members and exhibitors may wish to take advantage of this and so secure full benefit from the co-ordinated displays.

Interested manufacturers who have not received an application form should apply immediately to either the Export Promotion Department (Exhibitions Branch), 27, Old Queen Street, London, S.W.1, or to the Birmingham Chamber of Commerce, 95, New Street, Birmingham.

IT IS REPORTED that a group of German firms will export 200,000 tons of scrap iron to Britain in the next six months.

Imports and Exports of Iron and Steel

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in June, and the first six months of 1948. Figures for the corresponding period of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel

Destination.	June, 1948.	Six months ended June.	One-half of 1938.
	Tons.	Tons.	Tons.
Eire	6,146	36,223	27,860
Channel Islands	704	4,864	3,708
Gibraltar	89	1,593	442
Malta and Gozo	492	1,930	1,152
Cyprus	298	2,125	828
Palestine	1,205	10,868	4,036
British West Africa	2,472	22,626	24,872
Union of South Africa	12,288	70,351	115,544
Northern Rhodesia	933	3,915	10,288
Southern Rhodesia	1,928	8,802	18,106
British East Africa	6,507	33,374	12,966
Bahrein, Kuwait, Qatar and Trucial Oman	1,684	16,095	*
India, Pakistan, etc.	6,947	40,134	79,340
British Malaya	2,218	12,339	33,292
Ceylon	638	4,960	13,016
North Borneo	2,818	6,746	57
Hong Kong	3,194	15,218	11,798
Australia	5,708	37,372	85,452
New Zealand	3,942	30,771	65,942
Canada	2,291	10,076	42,704
British West Indies	2,529	13,535	22,126
British Guiana	464	2,486	1,498
Anglo-Egyptian Sudan	681	5,115	4,146
Other British countries	1,670	8,255	6,993
Russia	30	13,119	2,174
Finland	6,486	36,352	8,804
Sweden	8,765	51,630	5,987
Norway	7,349	28,401	10,136
Iceland	623	2,418	330
Denmark	5,757	36,292	43,628
Poland	7	769	1,244
Netherlands	9,139	43,956	25,780
Belgium	924	6,147	10,162
France	735	6,656	6,694
Switzerland	1,614	9,619	1,391
Portugal	1,784	14,321	3,856
Spain	505	2,937	3,882
Italy	603	2,321	2,570
Hungary	218	287	16
Czechoslovakia	33	195	1,158
Greece	93	1,777	876
Turkey	1,269	9,018	6,878
Dutch East Indies	2,457	11,330	13,654
Dutch West India Islands	996	4,470	1,232
Belgian Congo	86	667	152
Algeria	17	331	26
Portuguese East Africa	127	1,132	7,110
Syria	768	1,592	1,303
Lebanon	1,164	3,308	
Egypt	5,453	25,155	17,204
Iraq	5,073	27,624	12,870
Iran	10,220	58,102	55,190
Burma	3,237	16,103	9,256
Siam (Thailand)	717	1,715	2,998
China	1,472	10,788	11,255
U.S.A.	196	1,035	1,094
Cuba	82	1,587	361
Colombia	777	3,949	1,912
Venezuela	4,397	25,719	2,338
Ecuador	87	1,443	796
Peru	264	2,097	1,516
Chile	957	5,003	3,146
Brazil	64	9,082	8,496
Uruguay	495	4,907	3,794
Argentine	6,073	38,931	39,678
Other foreign countries	2,848	15,600	40,825
Total	161,807	937,658	957,938

* Included in "Other British countries" and "Other foreign untries."

Total Imports of Iron and Steel

From	June, 1948.	Six months ended June.	One-half of 1938.
	Tons.	Tons.	Tons.
Australia	993	9,971	18
Canada	10,419	40,873	58,688
Other British countries	324	2,722	80,616
Sweden	1,417	8,136	44,898
Norway	2,518	14,247	16,888
Germany	18	1,625	47,999
Belgium	13,414	54,555	136,840
Luxemburg	453	3,086	29,300
U.S.A.	9,837	65,952	100,346
Other foreign countries	5,744	18,234	156,555
Total	45,137	219,401	672,135
Iron ore and concentrates—			
Manganiferous	—	4,500	31,142
Other sorts	807,902	4,280,668	2,550,936
Iron and steel scrap and waste, fit only for the recovery of metal	60,710	276,893	316,102

Exports of Iron and Steel by Products

Product.	June, 1948.	Six months ended June.	One-half of 1938.
	Tons.	Tons.	Tons.
Pig-iron	98	392	46,970
Ferro-alloys, etc.—			
Ferro-tungsten	41	418	258
Spiegeleisen, ferro-manganese	65	2,381	2,598
All other descriptions*	83	366	524
Ingots, blooms, billets and slabs	568	2,898	4,872
Iron bars and rods	448	2,706	1,598
Sheet and tinplate bars, wire rods	518	2,150	7,780
Bright-steel bars	1,696	11,878	3,294
Other steel bars and rods	9,335	54,085	51,006
Special steel	1,599	10,011	2,466
Angles, shapes and sections	6,876	42,203	33,437
Castings and forgings	373	3,163	810
Girders, beams, joists and pillars	1,057	10,449	16,736
Hoop and strip	3,120	18,245	18,688
Plates ⅛ in. thick and over	9,565	60,315	65,484
Black plates	4,894	33,229	7,270
Black sheets	2,306	15,071	31,756
Galvanised sheets	6,799	35,708	73,463
Tinplates	14,094	97,866	159,660
Tinned sheets	428	2,346	706
Terneplates	33	118	2,162
Decorated tinplates	92	526	2,184
Other coated plates	377	1,903	113
Cast-iron pipes, up to 6-in. dia.	4,885	29,833	24,464
Do., over 6-in. dia.	6,468	26,599	21,482
Wrought-iron tubes	31,254	146,923	109,986
Radiators and central-heating boilers	256	1,713	2,014
Railway material	11,287	85,501	79,078
Wire	3,021	19,273	27,592
Cable and rope	2,552	13,433	8,200
Netting, fencing and mesh	1,339	8,702	4,708
Other wire manufactures	744	3,482	1,836
Nails, tacks, etc.	725	3,289	1,904
Rivets and washers	896	3,937	4,268
Wood screws	369	2,584	1,256
Bolts, nuts and metal screws	1,809	10,154	8,786
Stoves, grates, etc. (excl. gas)	1,103	5,976	3,503
Do., gas	239	1,459	1,073
Sanitary cisterns	152	739	1,406
Fencing material	343	1,646	2,566
Anchors, etc.	708	4,805	3,168
Chains, etc.	819	4,640	3,146
Springs	701	3,273	1,966
Hollow-ware	8,008	40,485	5,352
All other manufactures	19,664	110,785	106,344
Total	161,807	937,658	957,938

* The figures for 1938 are not completely comparable with those for subsequent years.

Obituary

MR. LACHLAN MACKINTOSH, late of the Singer Manufacturing Company, Limited, Glasgow, died recently.

MR. JOSEPH LAWRENCE, formerly works manager of the British Aluminium Company, Limited, at Milton, Staffs, died recently, aged 79.

MR. J. J. KELLY, co-founder and director of Kelly & Cleaver, Limited, ironfounders, etc., of Walworth Road, London, S.E.17, died on July 18. He was 81.

MR. WILLIAM STEWART, late managing director of the Coalbrookdale Company, Limited, ironfounders, of Wellington, Salop, died on July 7, in his 89th year.

MR. ARTHUR FITTON FIELDING, late of Fielding & Platt, Limited, manufacturers of hydraulic presses, pumps, etc., of Gloucester, died on July 17. He was 71 years of age.

MR. R. B. WEBBER, outside manager of the Central Marine Engine Works of William Gray & Company, Limited, West Hartlepool, until his retirement three years ago, has died at the age of 72.

MR. J. W. COLPITTS, founder of J. W. Colpitts & Company, Limited, marine engineers, of Blyth, Northumberland, has died at the age of 81. He was a vice-president of the Blyth Quaysiders' Association.

MR. WALTER CHARLES NORTON, who retired from his position as works manager of the engine fitting and erecting department of Ransomes, Sims & Jefferies, Limited, engineers and ironfounders, etc., of Ipswich, in 1931, has died after a short illness. He joined the company as an apprentice engineer.

MR. ALFRED DAVIS, joint managing director and general manager of John G. Kincaid & Company, Limited, marine engineers and boilermakers, of Greenock, has died while on holiday in Lancashire. Mr. Davis, who had wide experience of Diesel engines, joined the board of John G. Kincaid & Company in 1939 as general manager, and was appointed joint managing director with Mr. Robert Greer about two years ago.

MR. W. S. MALCOLM, for many years well known in the iron trade of the Midlands, has died at the age of 88. In 1905 he accepted a post with the Coalbrookdale Company, Limited, ironfounders, of Wellington, Salop, where he was first manager and afterwards for many years managing director. He retired from that position some years ago and afterwards became chairman of the National Association of Roofing and Tile Manufacturers.

MR. ARTHUR L. BRACKENBURY, consulting marine engineer and ship surveyor, of Hull, has died at the age of 65. He had been a member of the Society of Consulting Marine Engineers and Ship Surveyors since 1934. He acted as superintendent engineer with Hellyer Bros., Limited, Hull, and was outside manager of John G. Kincaid & Company, Limited, Greenock, for 11¼ years, subsequently becoming engineer and assistant works manager of Earles' Shipbuilding & Engineering Company, Limited, Hull. He had practised as an independent consultant since 1932, and acted as local superintendent of Rethymnis & Kulukundis, Limited, London.

MR. DONALD BRIGHT HOSEASON, Director of Studies at the Administrative Staff College, and a vice-president of the Institution of Electrical Engineers, died in hospital on July 16 as a result of a motor accident. Born in 1899, he joined the British Westinghouse Electrical Manufacturing Company in 1915. He became chief engineer of the Metro-Vick motor department in 1928, and his work included developments in cooling which allowed great reductions in weight and cost that helped put this country ahead of its competitors in this field. Mr. Hoseason joined the Brush Electrical Company, Limited, in 1940, becoming assistant managing director. He was a member of the Institute of Mechanical Engineers. In 1947 he was appointed as the first Director of Studies at the Administrative Staff College.

Engineering Mission to Canada

Mr. A. G. Bottomley, Secretary for Overseas Trade, announced in the House of Commons last week that the objects of the forthcoming engineering mission to Canada were to investigate market possibilities mainly for the heavier types of industrial engineering equipment; to obtain first-hand information on any difficulties in regard to trade with Canada in the engineering industry, and to advise on the most suitable methods to adopt to secure a greater volume of exports from this country. The mission consists of 12 members and is sponsored by the Board of Trade and the charge on public funds is expected to be about £5,000.

The leader of the mission is Mr. E. H. Gilpin, a director of Baker Perkins, Limited, Peterborough, and chairman of the British Food Machinery Manufacturers' Association.

The members are:—Mr. N. Neville (associate organiser of the mission), Director of the British Food Machinery Manufacturers' Association and also of the British Chemical Plant Manufacturers' Association; Mr. E. B. Ball, a director of Glenfield & Kennedy, Limited, Kilmarnock; Mr. A. W. Berry, Director of the British Engineers' Association; Mr. W. R. Beswick, a director of the Power-Gas Corporation, Limited, Stockton-on-Tees, and of Ashmore, Benson, Pease & Company, Limited, Stockton; Mr. D. M. Buist, Director of the British Electrical and Allied Manufacturers' Association; Mr. F. C. Fitzpatrick, Amalgamated Engineering Union; Mr. A. G. Grant, a director of Whessoe, Limited, Darlington; Mr. C. S. Robinson, a director of Thomas Robinson & Son, Limited, Rochdale; Mr. H. V. Yorke, a director of Bennett, Sons & Shears, Limited, Birmingham, and H. Pontifex & Sons, Limited, also of Birmingham.

The mission will be accompanied by a representative of the Ministry of Supply, and by one of the United Kingdom Trade Commissioners in Canada.

ARRANGEMENTS HAVE BEEN COMPLETED for Hepworth & Grandage, Limited, manufacturers of pistons, cylinder liners, etc., of Bradford, to open a factory in Auckland, New Zealand.

News in Brief

ASSOCIATED BRITISH OIL ENGINES, LIMITED, has received an order from the Barbados Electric Supply Corporation for one 900-kw. Diesel generating set.

DAVID BROWN & SONS (HUDDERSFIELD), LIMITED, announces that, with effect from July 31, its London office will occupy premises on the ground floor of Bush House, Aldwych, W.C.2 (telephone: Temple Bar 0867-9).

THE RENOLD & COVENTRY CHAIN COMPANY, LIMITED, Didsbury, Manchester, announces that for the 40 weeks ended April 4, the profit to be shared among 4,300 employees amounts to £37,854, each employee receiving about one and a half weeks' wages.

MUREX, LIMITED, Rainham, Essex, announces that it is now producing zirconium hydride, which previously had to be imported from the United States. It is made in powder form, and contains about 98 per cent. Zr, the balance being mainly hydrogen.

A STATOR WEIGHING 103 tons, built by C. A. Parsons & Company, Limited, Heaton, Newcastle-upon-Tyne, has been delivered to Dunston Power Station. The journey from Heaton to Dunston by railway took three hours and in some parts there was a clearance of only a few inches.

AN ADDITIONAL blast furnace which was laid idle last September for repairs was blown in on July 17 at the Normanby Ironworks of Pease & Partners, Limited. Previously there were only two furnaces in operation at this plant and the extra output of hematite is expected to average over 1,000 tons per week.

AS FROM AUGUST 3, that section of the Board of Trade Export Licensing Branch operating from 4, Fenchurch Avenue, will be removed to Regis House, King William Street, London, E.C.4 (telephone: Avenue 3111). The headquarters of the branch will remain at Stafford House, King William Street, E.C.4.

AT THE EXTRAORDINARY MEETING of Anglo-Transvaal Industries, Limited, Johannesburg, on July 15, resolutions for acquiring the controlling interest in Boulton & Paul, Limited, structural engineers, etc., of Norwich, were passed. The net proceeds of the issues will be about £1,550,000, and after acquisitions and repaying loans amounting to £350,000, a balance of £450,000 will be available for working capital.

National Gas & Oil Engine Company

The National Gas & Oil Engine Company, Limited, is discontinuing the manufacture of a number of sizes of engines and is concentrating its manufacturing capacity on those sizes which are in greatest demand. It is expected that the output of engines will be increased, resulting in earlier deliveries.

The directors emphasise that no negotiations of any kind are in progress, or intended, to alter the status of the company or to link it with other manufacturers of oil engines.

Personal

MR. HUBERT C. NICHOLSON has been elected a director of the Brightside Foundry & Engineering Company, Limited.

MR. THOMAS DUNN, who was head buyer of the Consett Iron Company, Limited, has retired after 50 years' service with the company.

MR. HUGH B. MCFADZEAN, managing director of Alexander Jack & Sons, Limited, agricultural engineers, of Maybole, Ayrshire, was presented with a cheque and a pair of binoculars at the annual meeting of the Scottish Agricultural Machinery Association in Edinburgh, on July 15, as a mark of appreciation for his services to the trade and to the association, of which he is a former vice-president.

MR. ALBERT LEIGH, a director of Allott Bros. & Leigh, Limited, engineers and boilermakers; MR. A. ROBERT JENKINS, a director of Robert Jenkins & Company, Limited, engineers; MR. HERBERT MCWHINNIE, general sales manager of the Steel, Peech & Tozer branch of the United Steel Companies, Limited, and of the United Strip & Bar Mills branch of the United Steel Companies, and MR. C. H. T. WILLIAMS, joint managing director of the Park Gate Iron & Steel Company, Limited, are among those to have been appointed Justices of the Peace for the Borough of Rotherham.

MR. F. B. RICHARDS, while retaining the chairmanship of the company, has relinquished his position as a joint managing director of the Woodall-Duckham Vertical Retort & Oven Construction Company (1920), Limited. MR. G. J. JACKSON will continue as a joint managing director until his retirement from the board on December 31, 1948. Arrangements have been made to retain his services after that date in a part-time consultative capacity. He will retain his seat on the board of the parent company, Woodall-Duckham (1920), Limited. MR. J. S. JEFFREY and MR. D. RIDER have been appointed joint managing directors, while MR. T. C. FINLAYSON has been appointed deputy chairman.

Wills

GARRETT, F. J., a former director of the Scottish Iron & Steel Company, Limited £11,462

HAMS, A. B., formerly representative of Angle Abrasive Works, Limited, Wembley £8,067

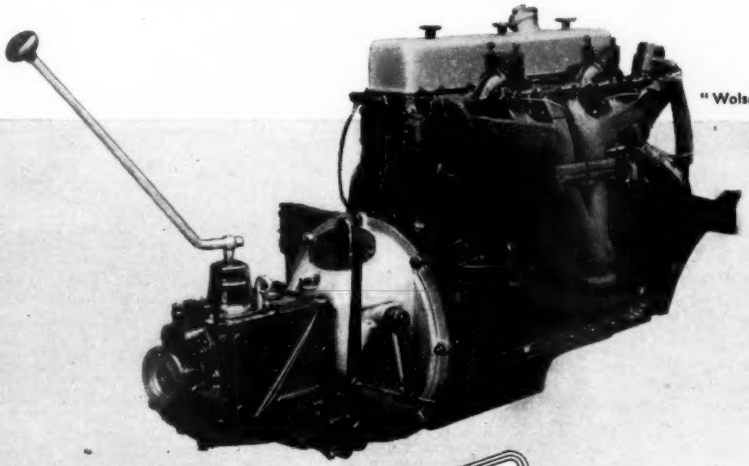
CAMPBELL, SIR NIGEL L., deputy chairman of Stewarts and Lloyds, Limited, a director of Stanton Ironworks Company, Limited, and other companies £92,242

SHORT, G. A., chairman of Short Bros., Limited, shipbuilders, of Pallion, Sunderland, and a member of the Worshipful Company of Shipwrights £64,193

JACKSON, S. H., chairman of the North Lonsdale Iron & Steel Company, Limited, a director of Millom & Askam Hematite Iron Company, Limited, and other companies £135,365

COADE, C. C., chief engineer with the Barrow Hematite Steel Company, Limited, and formerly for many years chief engineer of the Millom & Askam Iron Company, Limited £1,334

OWEN, H. J., a director of Pneulec, Limited, Dartmouth Auto Castings, Limited, and the Midland Motor Cylinder Company, Limited, and a local director, and for many years works manager, of Birmingham Aluminium Casting (1903) Company, Limited £2,868



"Wolseley 14 h.p. Engine."

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Using

STANTON-DALE

REFINED PIG IRON

USED AND RECOMMENDED
FOR ALL HIGH-DUTY
ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

Company News

(Figures for previous year in brackets.)

Rippingilles—Dividend of 7½% (same).

Mather & Platt—Interim dividend of 4% (same).

Noble & Lund—Interim dividend of 15% (same).

Davies & Metcalfe—Interim dividend of 3% (same).

Blythe Colour Works—Interim dividend of 20% (same).

Nail & Chain—Final dividend of 7½%, making 12½% (same).

London Aluminium Company—Interim dividend of 30% (25%).

National Bolts & Rivets—No dividend, against a payment of 12½%.

Percy E. Fisher (1928)—Final dividend of 40%, making 60% (same).

Bristol Tramways & Carriage Company—Interim dividend of 5%, tax free (same).

John Booth & Sons (Bolton)—Final dividend of 15%, making 25% (40% on smaller capital).

C. H. Bailey—Final dividend of 12½% (same) and capital bonus of 5% (nil), making 25% (20%).

Murex—Final dividend of 12½% per annum, making 20% per annum (same) for the 10 months to April 30.

Warne, Wright & Rowland—Second interim dividend of 25% (32½%), making 40% (same). No further dividend will be recommended for 1947.

Steel Corporation of Bengal—Net profit for 1947, £65,013 (£162,703); no ordinary dividend (8 annas per Rs. 10 share); forward, £45,356 (£25,326).

Crossley Bros.—Final dividend on the deferred shares of 8½%, making 12½% (same). The directors state that the accounts will not be available until October.

Greenwood & Batley—Net profit for the year ended March 31, after depreciation, income tax, etc., £40,904 (£52,844); to general reserve, £10,000 (same); final dividend of 10% making 15% (same); forward, £70,924 (£72,628).

Morgan Crucible Company—Profit for the year ended March 31, after tax, £522,937 (£441,834); final dividend of 8½%, making 12½% (same); to rehabilitation reserve, £100,000 (same); general reserve, £175,000 (£100,000); forward, £119,723 (£100,831).

Monks, Hall & Company—Net profit for the year ended April 3, after all usual charges, including tax and depreciation, £113,603 (£76,880); to general reserve, £28,367 (nil); interim dividend at the rate of 20% per annum, £24,000 (£66,000); no final ordinary dividend (£3,600); forward, £57,580 (£3,127).

Duple Motor Bodies—Net profit for the year ended March 31, after stock depreciation, income tax, etc., £156,578 (£66,803, after tax, for the initial period of 8½ months); to preference dividend, £5,500 (£3,896); final ordinary dividend of 12½%, making 20%, £44,000 (£31,167); future tax reserve, £110,000 (£20,000); forward, £8,818 (£11,740).

H. J. Baldwin & Company—Trading profit for the year ended March 31, after writing off exceptional loss of £6,339 incurred in trading with an associated company, £64,673 (£41,821); investments income, £1,210 (£1,481); dividends from subsidiary companies, nil (£2,675); net profits on sale of freehold properties, etc., £3,058 (nil); to depreciation of fixed assets, £6,654 (£4,361); taxation, £36,995 (£18,809); net profit, £25,292 (£22,807); dividend of 25% (same); staff welfare account, £3,057 (£888); staff remuneration adjustment account, £3,057 (£888); investment depreciation reserve, £857 (nil); general reserve, £2,201 (nil); forward, £27,524 (£26,804).

Edgar Allen & Company—Trading profit for the year ended April 3, £421,568 (£135,645); interest and dividends, including £50,847 non-recurring distribution from one company, £67,001 (£13,044); profits from subsidiary companies, £3,918 (£5,149); to depreciation, £43,137 (£38,718); staff pension scheme contributions, £7,312 (£7,134); directors' emoluments, £14,550 (£13,318); staff pensions, £161 (£154); leaving £427,327 (£94,514, to which was added £25,000 investment reserve in subsidiary no longer required, and £6,050 E.P.T. refund); to taxation, £213,500 (£42,050); reserve for replacement of fixed assets, £100,000 (nil); reserve for contingencies, £25,000 (£40,000); general reserve, £20,000 (same); dividend of 12½% (same); forward, £86,291 (£45,466).

British Blast Furnace for South Africa

Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees, has secured an order from the South African Iron & Steel Industrial Corporation, Limited, (Iscor), for a blast furnace to be erected at Vanderbijl Park, near Vereeniging. The furnace will have a production capacity of 850 tons of iron per day. It is planned to embody several constructional innovations, which will permit the furnace to give a marked improvement in efficiency.

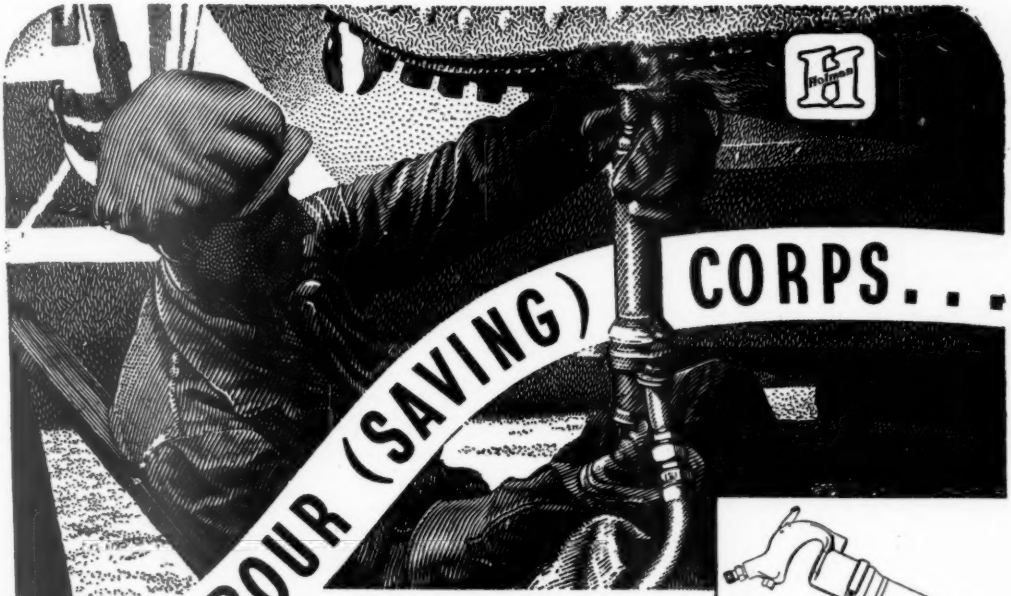
The latest order will bring the value of the work which Ashmore, Benson, Pease & Company has on hand at the present time for Iscor to over £2,000,000.

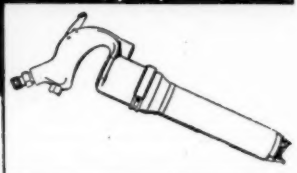
Increased Nickel Price

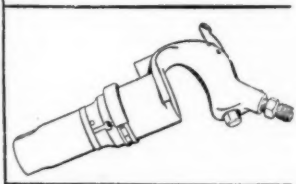
The International Nickel Company of Canada, Limited, and its associated companies, International Nickel in the United States and the Mond Nickel Company, Limited, in the United Kingdom, have announced that their prices for nickel were increased from July 22.

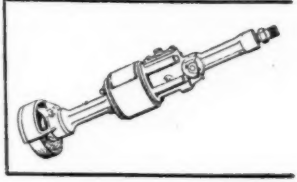
In Europe the Mond Nickel Company is raising its prices as follows:—In the U.K. to £224 per ton, delivered works; on the Continent to £227 per ton, c.i.f. Continental port. These prices correspond to those announced for Canada, the United States and the rest of the world. The increase in Europe is the first made by the companies since 1939.

The present change has been necessitated by the considerable and continued rise in costs, particularly in Canada.









World famous for their Riveting hammers, Holmans also produce a range of pneumatic tools. **Riveting Hammers.** The "X" series has long been the first choice for medium work. Now the "ER" group has been added to the range: the ER's are heavy duty tools capable of closing cup rivets of all sizes up to 1¾ in. **Chipping & Caulking Hammers.** These are tools that all operators like to use and the full range enables the right tool to be used for the right job. The Throttle Valve gives full control of weight of strike from light taps to full force blows. The adjustable Exhaust Deflector and the sensible grip make for comfortable working. **Grinding & Fettling Tools.** The Rotogrind series gives a choice of tools with a wide variety of application. 0/1 is the high speed job. Its weight is 4 lbs. all on and it will rev up to 16,000 P.M. Its light weight makes it a first-class tool for such delicate jobs as die dressing and its power and speed make it suitable for much general purpose work. Sizes 2 and 4 will take any grinding or fettling work that comes their way, their power/weight ratio is very high and they are the ideal tools to carry fast cutting wheels.

No: 5 is the Surface Type grinder and fettler, ideal for fettling large castings, and smoothing off welds:

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Holman PNEUMATIC TOOLS

The first name for lasting service.

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TBW

Raw Material Markets

Iron and Steel

It is officially stated that there has been "no further fall" in pig-iron stocks, but reserve supplies are very scanty both at the producing plants and at consumers' works, and the further expansion of output has become a matter of serious urgency. To this end an extra blast furnace has been blown in on hematite on the North-East Coast, where there are now 26 stacks in operation. The need for the expansion of supplies of high-phosphorus iron is also clearly apparent, but it would appear that the output of basic iron has at last overtaken the requirements of the melting shops. The revised scale of prices for coal will impose additional financial burdens on blast-furnacemen, and provides a further incentive to the practice of the most rigid economy in fuel consumption. In this direction, remarkable technical progress has been achieved and, with the same end in view, larger tonnages of high-grade foreign ore are being smelted.

There is positively no abatement of the pressure for all classes of semi-finished steel. Imports from the United States, the Continent, and the Dominions collectively represent a meagre contribution to the needs of the re-rolling industry, and the operation of the mills is largely governed by the extent of the deliveries of home-produced bars, billets, blooms, and slabs. Small billets are definitely in short supply, and even the sheet-mills, overwhelmed as they are with orders and further potential business, are not able to secure adequate tonnages of sheet bars.

The flow of orders and inquiries for all descriptions of finished steel products is still in full spate. There is not the slightest hint of recession in the demand for material for new constructional work and capital re-equipment. The volume of exports, restricted in the interests of home consumers, could be considerably increased, if supplies were available, but only a few industries high on the priority list are able to secure all the material they need. The home and export demand for black and galvanised sheets is profoundly impressive, and wire drawers cannot keep pace with current needs. Plate mills, too, have congested order-books and there is a large miscellaneous demand for constructional steel, railway and colliery equipment.

Non-ferrous Metals

Last week saw a price change in a metal which has remained at a fixed level since before the war and has, moreover, carried a well-deserved reputation for stability. On July 22 the quotation for nickel was raised from £190 to £224 per ton, but this relatively modest increase is certainly not expected to check consumption, for in the industrial scheme of things nickel is well established for a number of important purposes. In commenting on this increase in the nickel price the president of the International Nickel Company of Canada, Limited, has referred to the increases which have taken place in operating costs during the past decade, and mentioned also the question of exhaustion of ore reserves. This is quite an important matter and one to which every mining enterprise must pay serious attention, but the published figures of ore reserves belonging to the International Nickel Company have always been regarded as favourable. On the whole there is not likely to be much, if any, adverse criticism of the alteration in the nickel price, for, after all, the increase is less than 20 per cent., which, compared with 100 per cent. in copper and much more in lead and zinc, is very reasonable. It may be taken for granted, in view of the policy of the nickel producers, that this new price has come to stay; the modesty of the extent of the increase is a guarantee of this. With the others, however, there must be, in due course, and perhaps sooner than at present seems likely, a downward reaction which may amount to quite a sizeable figure.

The U.S. copper statistics for June, in short tons of 2,000 lb., are as follow:—Production of blister copper, 87,432 tons (compared with 91,526 tons in May); output of refined copper, 105,221 (104,524 tons in the previous month). Stocks of refined copper, at 73,065 tons, were a couple of hundred tons up from 72,791 tons, while domestic deliveries, at 111,927, came down from 113,389 tons in May. It is evident from these figures that activity in the United States is very well maintained, and as long as deliveries remain at a full 100,000 long tons every month there is not much chance of any setback in the ruling price of 21½ cents. There seems to have been a minor adjustment in the export quotation, which had stood at 21½ to 22½ cents, f.a.s. New York, and is now 21½ cents. So far as the consumers in the United Kingdom are concerned, this alteration is without significance, but to the extent that it affects the American E. and M.I. quotation it is of interest to the Ministry of Supply, which generally supposed to have purchase contracts based on its published price. It is, in fact, the most reliable "independent" yard stick of copper values in existence to-day.

Allocations of Tin Metal

Interim allocations of tin metal for the second half of 1948, totalling 28,810 long tons, have been made by the Combined Tin Committee. The allocations now made, together with those to be made to the countries which have not yet reported their requirements, represent at least 75 per cent. of the total allocations that can be expected during this period. The Committee plans to distribute in September the balance available after final statistics for the first half of 1948 have been studied.

Interim allocations include:—Australia, 195 tons; Canada, 1,755; France, 4,290; India, 2,135; New Zealand, 235; United States, 16,640 tons. They represent 65 per cent. of consumption requirements. The total which will be distributed on this basis is approximately 35,000 of the total availability of 46,000 tons.